ROYAL ASTRONOMICAL SOCIETY.

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MANUEL J. JOHNSON, Esq. President, in the Chair.

Hale Wortham, Esq., Royston, Herts; and
Thomas Minchin Goodeve, Esq., King's College,

were balloted for and duly elected Fellows of the Society.

In the List of Fellows of the Society recently published, the date of Lord Wrottesley's election is stated to be 1829, February 29. This is a mistake. The true date is 1820, February 29, his lordship having been one of the founders of the Society.

Information having been received from time to time, especially from Associates of the Society residing on the Continent, respecting irregularities in the transmission of the *Monthly Notices* to their respective destinations, it has been resolved, in future, to despatch the successive numbers, in all possible cases, by post, immediately after publication, the Society defraying the expense of postage. It is to be hoped that by this arrangement the irregularities which have occasioned so much annoyance will be effectually removed; but should a repetition of them occur in any instance, it will be desirable to give due notice thereof to the Secretaries of the Society.

The publication of the forty-third volume of the *Astronomische Nachrichten* has recently been commenced. Fellows of the Society desiring to become subscribers are requested to send an intimation to that effect to Mr. Williams, the Assistant-Secretary of the Society, who will also receive the subscriptions, which are *payable in advance.* The price of each volume is fifteen shillings. There generally appear two volumes in a year. The successive numbers of the Journal are delivered in England free of any charge for postage.

Discovery of a New Planet. By M. Chacornac.

Admiral Smyth has received a letter from M. Chacornac, announcing the discovery of a new planet by him on the 8th of February, at the Imperial Observatory, Paris. The following observed positions of the new body have also been forwarded by M. Chacornac. The star of comparison is 21963 Lalande :—

	Paris M.T. h m s	∂ R.A. m s	∂ Decl. ′ ″	No. of Comps.
Feb. 8, 1856	14 4 3·44	5 6·29	.....	3
,, ,,	14 27 35·44	.....	1 49·97	3
,, ,,	15 33 40·54	5 8·23	.....	2
,, ,,	16 36 36·34	.....	1 14·50	2
Feb. 9 ,,	12 30 10·39	5 35·82	.....	5
,, ,,	13 7 53·51	.....	4 17·35	3

Mean position of the star of comparison for January 1856, deduced from the Catalogue of Lalande :—

R.A. ... $11^h\ 26^m\ 58^s{\cdot}03$
Decl. ... $4^\circ\ 55'\ 6''{\cdot}4$

Elements of Leda. By M. C. F. Pape, Assistant at the Altona Observatory.

(*Communicated by Professor Challis.*)

M	20 10 13·1	1856, Jan. 13·45294 Berlin M.T.
ϖ	91 33 51·3	M. Eq. 1856·0
Ω	296 2 26·2	
i	6 31 19·7	
φ	11 0 50·4	
Log a	0·438739	
Log μ	2·891899	

These elements have been computed from the Paris observation, Jan. 13; one at Bilk, Jan. 20; and one at Berlin, Jan. 24.

Note on Saturn's Rings. By Warren De La Rue, Esq.

(*Extract of a Letter to the Editor.*)

"I have observed some phenomena in reference to *Saturn's* Rings, which I think it desirable to bring under the notice of

astronomers, as likely, if corroborated, to throw much light on the physical condition of the planet. For the last five or six years that I have been assiduously observing, measuring, and making drawings of *Saturn*, I have noticed irregularities in the widths of especially the two bright rings, and in the dark division between them, only to be accounted for, as it appears to me, by supposing, 1st. That the centre of the rings is not coincident with the centre of the planet; 2d. That the rings are not of the same breadth throughout; 3d. That they are, as proved by the form of the shadows, situated in different planes, and, moreover, that the nodes of the rings have a somewhat rapid motion. For I have frequently observed the rings wider at one extremity of their minor axes than accords with their breadths at the extremities of the major axes. Also, I have observed the same phenomena with respect to the principal dark division; and, moreover, that sometimes the eastern ansa of one of the bright rings is wider than the western, and *vice versâ*, by quantities quite appreciable to a practised eye, although difficult to determine exactly by measurement. From the concave form of the shadow, as at present seen on the middle ring, it is evident that this ring is elliptical in its section, and, I believe, of considerably greater thickness than that assigned usually to it. It would be very desirable to have the depth of this curvature of the shadow well determined by accurate micrometrical measurements, as it would afford data for determining the form and thickness of at least the middle ring.

"7 *St. Mary's Road, Canonbury, February* 2, 1856."

Note on the Rings of Saturn and on the Orbit of α Centauri.

By Captain W. S. Jacob.

(*Extract of a Letter to the Editor.*)

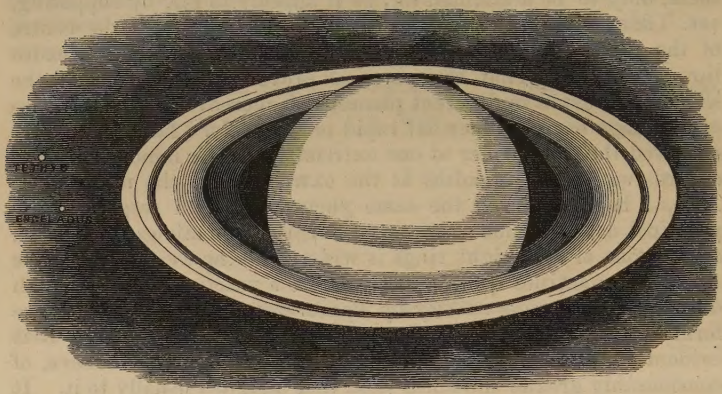
"We arrived here on the 29th December, and the accompanying drawing will show you that I have not been long in recommencing work. It represents *Saturn* as I saw him on the 8th instant at $6\frac{1}{2}^{h}$. The concave outline of the shadow I see plainly enough, yet cannot but think it an illusion; the more so as in a subsequent careful scrutiny, on the 10th, I could not be *quite sure* that the outline was not a straight line. The edge of the shadow in the faint ring I am unable to see, only I cannot trace the ring up to the planet in that part. I am quite unable to imagine any section for the bright ring (compatible with its ascertained thinness) that would give such an outline to the shadow. I am making a series of micrometric measures of the rings, and will communicate the result when complete.

"*α Centauri* has advanced considerably, and come to very

nearly its minimum distance for the present; five days' observations give:—

Epoch, 1856·015 302°·24 3″·806

The periastral time will not, I think, differ much from 1862·5.



"*Madras, January* 12, 1856."

Note on Solar Refraction. By Professor C. Piazzi Smyth, Royal Observatory, Edinburgh.

This term of "solar refraction" was given by Professor W. Thomson to characterise an effect which he had deduced theoretically from the dynamical theory of heat, and, if proved to exist, is pregnant with important consequences to every part of astronomy.

For it at once infers the necessity of the existence of a medium pervading space,—a medium, though rare, of similar constitution to our own atmosphere, and undergoing by necessity a condensation in the neighbourhood of the sun. Hence, he showed, that there cannot but arise a refraction of objects beyond the sun, when this body crosses their line of direction.

The theory could do but little beyond pointing to the fact of some amount of such solar refraction, while the exact amount could only be ascertained by astronomical measures. But with a comparatively small number of such observations, there seemed thus a promise of obtaining speedily a quantitative result,—a result, too, bearing immediately on the much-vexed question of a resisting medium, to approach which, at present, astronomers have scarcely any other method than that of cometary perturbations, wherein are mixed up so many other unknown quantities, and wherein the opportunities for observation are so rare, that generations may pass away before anything decisive is arrived at.

I determined, therefore, to inquire into the subject from Professor W. Thomson's point of view; and the best practical method at my command for testing this "solar refraction" seemed to be the observation of stars transiting the meridian in the neighbourhood of the sun; and for this purpose the large object-glass of the Edinburgh transit instrument was very favourable.

But although extraordinary precautions were taken in darkening the observing-room, and using various devices to improve the telescopic vision, it was found that the thick atmosphere of a town, and one so nearly on the sea-level, was almost always so brilliantly illuminated in the neighbourhood of the sun, that no stars could be observed, or even seen, under the desired conditions. On one occasion, however, in the past history of the Observatory, a unique state of the air enabled a star to be observed in what might be expected to be a possible refracting distance from the sun, while two others had also been observed the same day, at a distance so much greater, that they might safely, as a first approximation, be considered to be out of the range of disturbance.

Now, according to Professor W. Thomson's deduction from the dynamical theory of heat, the star in the neighbourhood of the sun, *α Orionis*, should have appeared closer to the other stars, *β Orionis* and *α Aurigæ*, on that day than at any other time of the year; and there were plenty of observations of the same stars during other months, when they all transited at night, completely out of reach of the solar influence.

What result, then, do the observations show? Why, after special computation, which has not sensibly altered the result from the original computation, made before the appearance of the dynamical theory of heat, *α Orionis* appears to have been visibly closer in R.A. to *β Orionis* by 0·06 of a second of time; and closer to *α Aurigæ* by 0·04 of a second of time.

The two results are, therefore, confirmatory of each other, and of the existence of the "solar refraction," and with that of a resisting medium filling space, and forming a material connexion still, and strengthening the idea of unity between the sun and all the planets.

But can we depend on this result? Or ought we to be satisfied with it? The mere arithmetic of it looks well; but those who have had much practice in striving after the highest attainable exactness, and know the innumerable sources of possible error in every astronomical operation, would very properly not be content when the effect sought for is so excessively minute, except with a large number of observations, and on many different stars; some, too, with the sun seen between them, and in the direction of N.P.D. as well as of R.A.

How, then, are such observations to be obtained? As far as my experience goes, there is no chance of obtaining them with any instruments at any observatory already established; and this by reason of the great depth of illuminated atmosphere through which such observatory must always look. But if our instruments could

be temporarily transported to the summit of such a mountain as the Peak of Teneriffe, where 10,000 feet in depth of the grosser part of the atmosphere would be eliminated, there is every probability that a satisfactory result would be obtained in the course of a single summer.

Not only, too, would a knowledge of a most important element in the constitution of the solar system be procured, but we should have a proof of the cosmical character and universal bearing of the dynamical theory of heat,—a theory which has been elaborated by the mathematicians of our own time and our own country.

Observations hereinbefore referred to.

Date, 23^h, June 20, 1838.

Name of Star.	Distance from Sun in R.A.	Distance from Sun in N.P.D.	Transits (5 Wires) Corrected for Error of Coll. Level and Azimuth.	Tabular Apparent Places.
	h m	o ′	h m s	h m s
α Aurigæ	0 54	+22 22	5 3 58·91	5 4 43·70
β Orionis	0 52	+31 52	5 6 0·37	5 6 45·14
α Orionis	0 12	−16 6	5 45 39·29	5 46 24·12

From these numbers flow the following results:—

Names of Stars Employed.	Difference Observed.	Difference Computed.	Difference of Obs^d and Comp^d, or Solar Refraction
	m s	m s	s
α Orionis − β Orionis	39 38·92	39 38·98	+0·06
α Orionis − α Aurigæ	41 40·38	41 40·42	+0·04

In re-computing these observations for the special purpose now in view, I have not found any reason for altering the corrections for errors of collimation level and azimuth adopted at the time by Professor Henderson. Some sensible difference came out between our clock *errors*, but none between our *rates;* and this rate, which was alone of importance in the new inquiry, was shown to be under 0·01 of a second.

This resulting inappreciable effect of the clock-rate is, too, all the more satisfactory, inasmuch as I computed the corrections to the *apparent* places of the stars with new constants adapted to the instant of observation, and derived the *mean* places from all the Edinburgh measures made in the year in question.

As regards, then, the possible inaccuracy of the numerical corrections for error of instrument and clock, the upper limit must, I think, be considered to be less than the fraction representing the expected solar influence. But there is still the question of the sufficiency or power of accuracy of the original transits observed, especially seeing that they are each observed over five wires only.

To enable astronomers to form their own opinion on this point, I submit herewith the differences of each wire observed, from the

time computed for it from the mean of the whole number of wires, the measured value of the intervals and the declination of the star.

Error of Observation of each Wire on the Mean of the Five.

Name of Star.	1st Wire.	2d Wire.	3d Wire.	4th Wire.	5th Wire.
	s.	s.	s.	s.	s.
α Aurigæ	+0·102	+0·058	−0·003	−0·109	−0·049
β Orionis	+0·032	+0·053	−0·036	+0·013	−0·062
α Orionis	+0·058	+0·046	+0·024	+0·041	−0·168

There may be some difference of opinion as to what the probable error of the mean for each star may be, but there can be little doubt of its being under the now declared quantity of "solar refraction;" and there can be no doubt at all as to the merit of the observer, Mr. Alexander Wallace, the assistant astronomer of the Observatory, the characteristic excellence of whose transits for many years past has enabled the three observations now under discussion to assume an importance which has seldom fallen to the lot of any other three transits.

Royal Observatory, Edinburgh, Jan. 9, 1856.

Note on the Orbit of α Centauri and on the Rings of Saturn.

By Captain W. S. Jacob.

(*Extract of a Letter to the Editor.*)

"I have to communicate a matter of great interest regarding *α Centauri*. Finding from my observations communicated by last mail that the pair must have come to about their minimum of distance, I thought something like a good approximation to the orbit might be procured, especially as the observations of Richaud in 1690, and Feuillée in 1709, seem to bring both the period and perihelion passage within very narrow limits:* viz. the former between 77^{yrs} and $79^{yrs}\cdot 5$, and the latter between 1862·4 and 1844·2. But on laying down an ellipse which would pass through the positions of 1834, 1848, and 1856, and computing intermediate points, to my dismay I found *enormous* errors, and the largest of all at those epochs which had been best observed, and where the observations were most accordant *inter se*, viz. about 1852–3. I then set to work to project the observed distances as well as angles into a curve, with the time for a co-ordinate, and on attempting to bring these into agreement, found them altogether incompatible, not only with each other, but with any kind of elliptic motion. Lastly, I took out the places independently from the two curves without

* These points will be more fully discussed in a paper about to be presented to the Society by E. B. Powell, Esq.

any sort of adjustment, merely reading off the angles and distances for each complete year, and laid them down in contiguity with the ellipse; the result is shown in fig. 1, where these places are marked +, and exhibit a very regular epicyclic curve, in which the revolution of the star round the proper elliptic place can be traced throughout, the places corresponding to Kepler's law of equal areas being marked by the short oblique lines cutting the curve.

"In order to show how very little the actual observations are altered by projecting them into curves, I have laid down in fig. 2 on a larger scale the places* as taken from the observation books, *without any preparation* beyond taking the means for the different epochs; and although, as might be expected, the curve is not quite so regular as before, yet its course is marked with sufficient distinctness. (The places are marked ○.) The jump from *a* to *b* is partly accounted for by a change from daylight to night observations—the day measures of distance being usually shorter than those by night. I think, then, there can be no hesitation in pronouncing on the existence of a disturbing body. The disturbance is much more strongly marked than in the case of 70 *Ophiuchi*,† where it was the result of calculation and of a balance of errors; whereas here it is visible to the eye by inspection of the *unprepared observations*. Of course I am wrong in making the observed and mean places coincide at 1856·0, but there is no help for this, as the period of the disturbance is unknown, and will continue so for some years, as we have at present only six years of really accurate observations. The errors introduced by this assumption will not be very important, as they will be spread gradually over all the preceding places.

"Supposing my view of the matter to be correct, the distance must now be on the increase, and the place of 1857·0 cannot differ much from

317°·5 3″·90+

"The following are the results of five nights' measures of *Saturn* and his rings reduced to his mean distance; epoch, 1856·04442, Greenwich mean time:—

	″
Major Axis of Outer Ring, outside	39·997
— — fine line	37·966
— — inside	35·820
— Inner Ring, outside	34·859
— — inside	26·271
— Obscure Ring	22·214
— Planet	17·940
Minor Axis of Outer Ring	18·754

* From 1850 to 1856 being the only period in which the distance measures can be depended on.

† *Vide Monthly Notices*, vol. xv. p. 228.

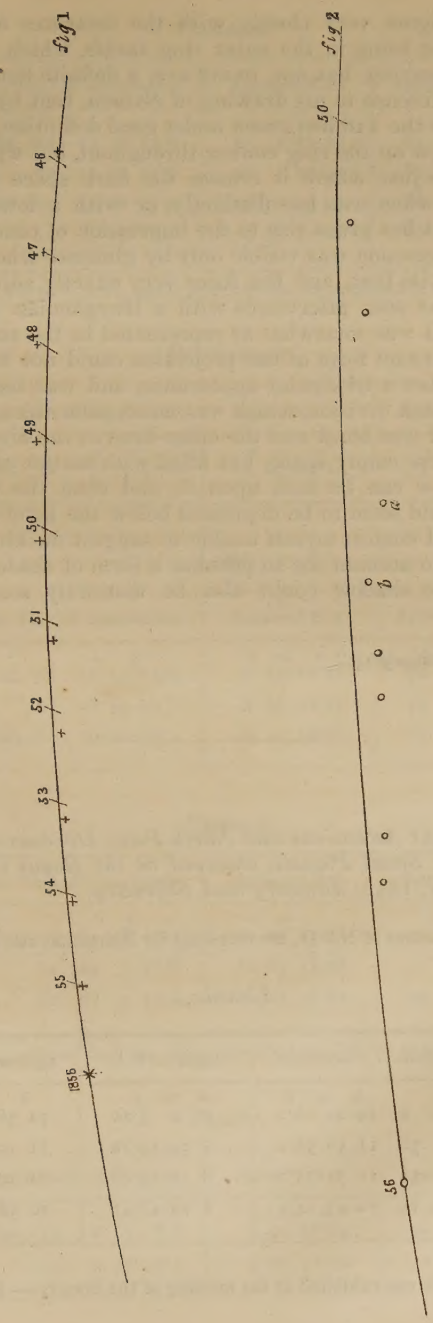


Fig 1
46
47
48
49
50
51
52
53
54
55
1855
Fig 2
50
a
b
56

"These agree very closely with the measures of 1853, the chief difference being in the outer ring *inside*, which, as you may see in my engraving, has not, to my eye, a definite boundary.

"With reference to my drawing of *Saturn*, sent by last mail, I have since, on the 22d inst., seen under good definition, with power 365, the shadow on the ring *convex* throughout, but with a kind of projecting *ear* just where it crosses the dark space between the rings, which, when seen less distinctly, or with a lower power, is doubtless what has given rise to the impression of concavity; as it was, the phenomenon was visible only by glimpses when the atmosphere was at its best, and the focus very exactly adjusted. The same thing was seen afterwards with a Huyghenian eye-piece of about 300. It was somewhat as represented in the accompanying sketch;* the exact form of the projection could not be made out, but it had rather a triangular appearance, and was seen distinctly crossing the dark division, which was much paler than the shadow; the one indeed was *black* and the other brown; the division, therefore, is not mere empty space, but filled with matter of some kind, since a shadow can be seen upon it, and from the form of the shadow it would seem to be depressed below the level of the other rings, though I confess myself unable to suggest the kind of section it must have to account for so peculiar a form of shadow.

"P.S. The shadow could also be distinctly seen upon the obscure ring.

"*Madras, January* 19."

Apparent Right Ascensions and North Polar Distances of recently discovered Small Planets, observed at the Royal Observatory, Greenwich, 1856, January and February.

The observations of N.P.D. are corrected for Refraction and Parallax.

Urania.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
	h m s	° ′ ″
1856, Jan. 2 14 14 26·1	9 2 3·20	72 36 8·56
30 11 56 56·1	8 34 34·28	71 15 26·36
31 11 51 55·7	8 33 29·56	71 12 31·76
Feb. 14 10 43 14·1	8 19 48·47	70 38 39·46

* This was exhibited at the meeting of the Society.—Ed.

Pomona.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Jan. 24 13 50 54·9	10 5 12·50	87 24 24·02
30 13 23 35·0	10 1 27·39	87 11 25·61
Feb. 12 12 21 46·0	9 50 43·45	86 20 12·44
14 12 12 8·0	9 48 57·00	86 10 6·08

Jan. 24. There is some doubt whether the above object is the planet.

Parthenope.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Jan. 10 7 31 42·8	2 49 46·21	79 5 52·37

Leda.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Jan. 28 11 54 25·9	8 24 10·58	72 42 31·59
29 11 49 30·7	8 23 11·12	72 42 37·06
Feb. 12 10 41 57·7	8 10 38·78	72 47 5·72

Victoria.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Jan. 15 14 48 53·4	10 27 51·42	92 50 2·50
24 14 7 37·8	10 21 58·08	.....
30 13 39 43·8	10 17 38·88	92 47 21·30

It appears probable that the object observed on Jan. 15 is not the planet.

Psyche.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Jan. 15 8 3 6·8	3 40 58·24	74 24 3·78
23 7 33 32·7	3 42 51·74	74 4 53·28

Euphrosyne.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Jan. 30 14 37 5·3	11 15 9·81	42 59 44·45
Feb. 14 13 21 47·1	10 58 47·59	41 56 17·04

Iris.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Jan. 11 10 6 59·0	5 29 24·52	69 37 32·40
15 9 49 25·3	5 27 34·13	69 49 26·05
25 9 8 41·9	5 26 9·61	70 10 4·46
28 8 56 30·6	5 25 46·00	70 17 20·98
29 8 52 41·9	5 25 53·29	70 18 47·72
30 8 48 55·2	5 26 2·52	70 20 15·99
Feb. 16 7 49 54·9	5 33 53·90	70 32 52·15

Polyhymnia.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Jan. 15 13 23 5·2	9 1 49·19	70 29 26·92
Feb. 12 11 8 3·0	8 36 48 41	.....

Egeria.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Jan. 30 14 34 35·7	11 12 39·79	56 11 49·65
Feb. 14 13 23 40·5	11 0 41·29	54 30 23·23

The object observed on Jan. 30 is probably not the planet.

Description of an Observatory erected by Frederick Brodie, F.R.A.S., at Eastbourne, Sussex.

The following short description of what may be termed a *portable* observatory may be useful to those amateur astronomers who may not be permanently resident at any one place for many

years together, or who may possibly change their residence several times during the course of their lives. In proof of the feasibility of this plan, the author first erected this observatory in Somersetshire, and has since removed it into Sussex, some 160 miles distant. The time occupied in taking the whole of it to pieces, packing up the parts in sequences of numbers, and placing it on a railway, was from *four* to *five days*. The re-erection of the building will take at least ten days or a fortnight.

The building is entirely of wood, and rests on about 20 small brick pillars, which rise to about 8 or 10 inches above the ground, so as to keep the building free from damp. Upon these small pillars rests the *bottom cill*, 5 in. by 4 in., from which rise uprights, $2\frac{1}{2}$ in. by $3\frac{1}{2}$ in. at about intervals of 2 feet apart. Those uprights which support the dome are 4 in. by 4 in., and are placed only at the angles of the dome-room. The *top cill* is 4 in. by 3 in., upon which rests a flat roof of $\frac{3}{4}$-in. boards, having a small rise of 3 in. in the centre, to throw off the wet, and covered with canvass well painted with paint and varnish. The top cill of the dome-room is 5 in. by 4 in., upon which is placed a cast-iron ring in segments, slightly grooved for the balls of the dome to run upon. This top cill is circular, 15 feet diameter inside. The dome-room is a figure of 12 sides, two of the sides forming a connexion with the transit-room. It has also two windows.

The dimensions of the building are as follows:—

	ft.	in.
Diameter of dome at bottom	15	0
Ditto ditto at top	6	6
Height of dome	6	6
From floor to top of dome	14	6
Length of transit-room	20	6
Width of ditto	8	0
Height of ditto from floor	7	3

A portion of the transit-room, about 7 feet in length, is partitioned off, forming an entrance lobby, &c. The floor of the transit-room is about 3 in. above the bottom cill, and that of the dome-room about 4 in. above the transit-room.

The whole building is weatherboarded with 1-in. boards, all screwed on; the floors also are screwed down; nothing is nailed except fixtures, which do not require taking to pieces. The uprights and cills are morticed together and fixed with wooden pegs, so as to admit of being driven out when required. The weatherboarding has a lap of 1 in., upon which lap is tacked a strip of list, which keeps the sides weather-tight when screwed up. The floors and roof of transit-room are tongued with $\frac{3}{4}$-in. iron hooping.

The transit-shutters are 15 in. wide in clear opening. The top shutter is opened by a rope and pulley. The north shutter has a lens fixed in it of about 50 feet focus, at which distance a *meridian mark* is placed. This mark consists of a brass pin, $\frac{3}{4}$ in.

diameter, one end of which plays into two parts, for convenience of imbedding in brickwork; upon the pin fits a disc of brass 2½ in. diameter, and turning freely upon the pin, having a small wedge, to fix it, running through its centre. On one side of this disc is a small disc of iridium metal, having a black dot in its centre, in the centre of which, again, is a fine point of the iridium metal, having the effect of a white speck on a black ground. This metal is preferable to silver, it having no tendency to oxidise in the open air.

The lens which is fixed in the shutter of the transit, having a focus of 50 feet, at which distance the meridian-mark is placed, is only useful for collimating the transit-wires, or other temporary purposes, while adjusting the instrument; because the mere fact of its being attached to a wooden cell, which is ever liable to warp, and thereby slightly change the position of the lens, renders it totally unfit for a permanent reference to the meridian mark, since any such alteration in the position of the lens will disturb the coincidence of the transit-wires and meridian mark, making the appearance of an alteration in position of the meridian-mark itself, or the transit-instrument.

The *transit-instrument* is a 3-in. glass, by Merz, of Munich, 45 in. focal length, and rests on a cast-iron stand, fixed upon brickwork, having one circle on its axis, 10 in. diameter, divided to 15 minutes, and reading to 15 seconds. It has a sliding eye-piece, worked by a double-threaded screw, with a diagonal eye-piece for observing stars in zenith.

The *clock* is fixed to a post formed of two 3-in. planks, bolted together in the form of a T, and is fixed in rubble-work sunk in the ground. A Hardy's noddy on the top shows no tremor at any time.

The *dome* is in the form of a 12-sided cone without the apex. It is 15 feet diameter at the bottom, tapering to 6 ft. 6 in. at the top, having a height of 6 ft. 6 in. It has a sliding-shutter on either side, the clear opening of which is 21 in. These shutters are fitted with small brass runners, and work in grooves lined with thick hoop-iron, causing the shutter to slide freely. The top shutter on the dome is hung on hinges, and opens with a rope and pulley. The flat top of dome is covered with canvass well painted. The bottom cill is made of segments of wood 5 in. by 2 in. in two layers, put together with marine glue, and bolted with 4-in. coach-screws, the segments breaking joint with each other all round. There are four places where the joint is left unglued for the purpose of taking it to pieces. On the under-side of this cill are screwed two rings of bar-iron, 1 in. by ½ in. thick. These rings have an interval of 2 in. between them, so as to catch the cast-iron balls upon which the dome turns, on the right-angled corner of the bar-iron. By this arrangement a groove is formed for the balls, which has the effect of keeping the dome quite steady; and so easily is it turned, that even a single finger is sufficient for that purpose. An iron bar forms a handle by which the dome is turned. Although

so light and so easily moved, the form of the dome, and the manner in which it is hung, are such, that there is hardly any motion perceptible during the heavy south-west gales so prevalent on this coast. The top cill of the dome is a 12-sided figure made of wood-scantling, $2\frac{1}{2}$ in. by $3\frac{1}{2}$ in.; to this the rafters are screwed. The rafters are 2 in. by 3 in. An elm ring of board, $\frac{1}{2}$ in. thick and 6 in. broad, is screwed on outside the lower cill of dome, to give it stiffness, and to keep out rain and wind.

The equatorial telescope is made by Merz, of Munich; the object-glass is 6·4 in. in diameter, having a focal length of 8 ft. 6 in. The tube is made of wood, and is very light. The mounting is of peculiar construction, made in England, from drawings and designs of the author. It is a stand of cast-iron, in three pieces, each bolted firmly together, having lead between the joints, to lessen any liability to tremor. The bottom part is entirely below the floor of the observatory, and is a triangular plate, from which rises the upper part of the stand to a height of 6 feet. The northern side of the stand tapers from 3 ft. 6 in. at the bottom, to a width of 6 in. at the top. The adjusting screws for latitude and azimuth are attached to the bottom part of the frame. The polar axis is also bolted to the stand at the upper part, having two taper bearings bushed with brass; diameter of the bottom one, $3\frac{1}{4}$ in.; top one, $2\frac{1}{2}$ in. A cast-iron cradle turns on this axis, the bearings of which are also bushed with brass. To this is attached the hour-circle, while the top of this cradle carries the declination axis. On the top of the polar axis, and inside, at the top of the cradle, are two corresponding discs of steel, upon which the whole weight of the telescope cradle and declination axis rests; so that the cradle turns with a very small amount of friction. There is an adjusting screw, which acts on the discs, so as to lift the cradle from the taper bearings just enough to allow it to turn freely without lateral motion. The declination axis is made of brass, and is hollow; the end carrying the cradle of telescope has a bearing of $2\frac{1}{2}$ in. diameter; the other end has a bearing 2 in. diameter, and carries the circle and counterbalance. The declination circle is 18 in. diameter, and is divided on silver to 10″ reading to 10″ by the verniers. The hour-circle is 15 in. diameter, divided on silver to 2′ reading to 4″ by vernier. On the polar axis is fixed the clockwork and tangent screw. There is a shifting counterbalance fixed on the telescope for using with the position micrometer. The weight of the stand is about three-quarters of a ton, and the weight of the moving parts, together with a light tube, renders the telescope remarkably steady, and perfectly free from oscillation of any kind. The bottom part of the stand rests on three brick piers laid in cement.

To any gentleman who might wish for further information, the author will be happy to afford it.*

February 8, 1856.

* This description was accompanied with two photographs, which were exhibited at the meeting of the Society.—Ed.

The Minor Planets.

The following Table of the Minor Planets has been drawn up by Mr. Pogson of the Radcliffe Observatory, Oxford:—

No.	Name.	First Discoverer.	Place and Date of Discovery.		Period in days.	Ascen. Node.	Inclination.
						°	°
1	Ceres.....	Piazzi.....	Palermo ...	1801, Jan. 1	1681	81	11
2	Pallas	Olbers.....	Bremen	1802, Mar. 28	1683	173	35
3	Juno	Harding....	Lilienthal ..	1804, Sep. 1	1592	171	13
4	Vesta.....	Olbers.....	Bremen	1807, Mar. 29	1325	103	7
5	Astrea	Hencke	Driesen	1845, Dec. 8	1510	142	5
6	Hebe	Hencke	Driesen	1847, July 1	1379	139	15
7	Iris	Hind	London	1847, Aug. 13	1347	260	5
8	Flora	Hind	London	1847, Oct. 18	1193	110	6
9	Metis.....	Graham	Sligo.....	1848, April 25	1346	69	6
10	Hygeia	De Gasparis.	Naples.....	1849, April 12	2041	288	4
11	Parthenope .	De Gasparis.	Naples.....	1850, May 11	1402	125	5
12	Victoria....	Hind	London	1850, Sep. 13	1303	235	8
13	Egeria	De Gasparis.	Naples.....	1850, Nov. 2	1511	43	17
14	Irene	Hind	London	1851, May 19	1518	87	9
15	Eunomia ...	De Gasparis.	Naples.....	1851, July 29	1570	294	12
16	Psyche.....	De Gasparis.	Naples.....	1852, Mar. 17	1825	151	3
17	Thetis	Luther.....	Bilk	1852, April 17	1420	125	6
18	Melpomene .	Hind	London	1852, June 24	1270	150	10
19	Fortuna	Hind	London	1852, Aug. 22	1395	211	2
20	Massilia....	De Gasparis.	Naples.....	1852, Sep. 19	1366	207	1
21	Lutetia	Goldschmidt.	Paris	1852, Nov. 15	1387	80	3
22	Calliope....	Hind	London	1852, Nov. 16	1809	67	14
23	Thalia	Hind	London	1852, Dec. 15	1554	68	10
24	Themis	De Gasparis.	Naples.....	1853, April 5	2033	36	1
25	Phocea.....	Chacornac..	Paris	1853, April 7	1359	214	22
26	Proserpina..	Luther.....	Bilk	1853, May 5	1580	46	4
27	Euterpe....	Hind	London	1853, Nov. 8	1313	94	2
28	Bellona	Luther.....	Bilk	1854, March 1	1689	144	9
29	Amphitrite..	Marth	London	1854, March 1	1491	356	6
30	Urania.....	Hind	London	1854, July 22	1329	308	2
31	Euphrosyne .	Ferguson...	Washington .	1854, Sep. 1	2048	31	26
32	Pomona....	Goldschmidt.	Paris	1854, Oct. 26	1517	221	5
33	Polyhymnia .	Chacornac..	Paris	1854, Oct. 28	1772	9	2
34	Circe	Chacornac..	Paris	1855, April 6	1591	184	5
35	Leucothea ..	Luther.....	Bilk	1855, April 19	1800	357	8
36	Atalanta....	Goldschmidt.	Paris	1855, Oct. 5	1685	359	19
37	Fides	Luther.....	Bilk	1855, Oct. 5	1456	8	4
38	Leda	Chacornac..	Paris	1856, Jan. 12	1662	296	7
39		Chacornac..	Paris	1856, Feb. 8			

Positions Moyennes pour l'Epoque de 1790·0 *des Etoiles Circumpolaires, dont les Observations ont été publiées par Jérome Lalande dans les Mémoires de l'Académie de Paris de* 1789 *et* 1790. Par Ivan Fedorenko, Astronome Surnuméraire à l'Observatoire de Poulkowa. St. Petersbourg, 1854.

It is generally known that MM. Hansen and Nissen calculated tables to facilitate the reduction of the stars contained in the *Histoire Céleste* of Lalande, which were published in 1825 by Schumacher, and that these tables were employed in the final reduction of the same stars executed under the auspices of the British Association, the results of which were published in 1847.

But, independently of the observations of the *Histoire Céleste*, the *Memoirs of the Academy of Sciences* for 1789 and 1790 contain a considerable number of similar observations, for which auxiliary tables had not been calculated, and which, consequently, were not included in the catalogue published by the British Association in 1847. The author, accordingly, at the suggestion of M. W. Struve, undertook the reduction of these observations. The results are now published under the above title. In an Introduction, extending to seventy-nine pages, the author, after explaining the general principles of reduction employed by him, gives a list of the stars contained in the Catalogue, classified into zones, as in the original observations. The total number of zones is 52, and the total number of stars is 4673. The Introduction is followed by the Catalogue. The epoch as mentioned in the title is 1790·0. There is also a supplementary catalogue of 339 stars, founded on 13 zones, contained in the *Histoire Céleste*, but omitted in the *Catalogue of the British Association*, and on two zones in the *Memoirs of the Academy of Sciences*. The stars of this latter catalogue are all very near the pole, for in seven of the zones the mean declinations are included between 74° and 80°, and in eight of them between 80° and 90°. The stars are, also, in general, very small.

The U.S. Naval-Astronomical Expedition to the Southern Hemisphere during the years 1849–52, Lieut. J. M. Gilliss, Superintendent. Vols. I. and II. Washington, 1855.

It is generally known to astronomers that Dr. Gerling, of Marburg, having, in 1847, suggested the expediency of making observations of *Venus* near her inferior conjunction at different stations on the earth's surface, for the purpose of obtaining a new determination of the solar parallax, Lieut. Gilliss, U.S.N., to whom

Dr. Gerling had communicated his views, warmly adopted the project, and succeeded in inducing the government of his country to fit out an expedition for the purpose of carrying it into effect. The Republic of Chile, in South America, was selected as likely to offer a suitable locality for making observations of the planet, to be used with simultaneous observations, which it was contemplated to execute at the National Observatory, Washington. The superintendence of the operations in Chile was intrusted to Lieut. Gilliss, whose merits as a practical astronomer had been amply established by his labours in connexion with the United States Survey. The expedition sailed from the United States in the autumn of 1849. Having erected an observatory at Santiago, upon his arrival in Chile, Lieut. Gilliss was enabled to commence astronomical observations in the month of December of the same year. Besides observations of *Venus* near her inferior conjunction, the plan of his labours included observations of *Mars* near opposition, to be used also for obtaining a value of the solar parallax, and an extensive series of observations of stars in the southern hemisphere. It was also contemplated to make a series of meteorological and magnetical observations. The expedition returned to the United States towards the close of 1852, after an absence of three years and three months.

A work embodying the results of this important expedition has been drawn up by Lieut. Gilliss, and is now being published at the expense of the Government of the United States. Vols. I. and II. have already appeared. They relate to the geography, climate, &c., of Chile. The remaining volumes, which will be devoted to the main objects of the expedition, will also soon be published.

The principal instruments used in the expedition consisted of two refractors equatoreally mounted, a meridian circle, a clock, and three chronometers. The larger equatoreal, with which the differential and micrometrical observations were executed, had a focal length of $8\frac{1}{2}$ feet. The object-glass by Fitz, of New York, had a clear aperture of $6\frac{1}{2}$ inches. The meridian circle was executed by Pistor and Martins, of Berlin. It had a focal length of 6 feet, and an aperture of $4\frac{1}{3}$ inches.

The weather sometimes continued extremely favourable for observation during a long succession of nights.

"It was a great satisfaction," says the author, "to work with an instrument like ours, but there was almost too much of it. Out of 132 consecutive nights after the equatoreal was mounted there were only seven cloudy ones!"

Again, alluding to the state of the weather during the last summer of the expedition, the author says: "Between the 15th of December and the 15th of March, I had observations of *Mars* on seventy-eight nights! and out of one hundred and fifty-two, between November 10th and April 10th, there were observations with the meridian circle also on one hundred and twenty nights!

Thus we had the satisfaction to accumulate from a previously unexplored, or almost unexplored field, an amount of astronomical data which has probably never been equalled within a similar period of time."

It ought to be stated, however, that on other occasions the weather continued cloudy for several months in succession.

At page 81 of vol. i. we find the following description of the zodiacal light:—

"These are the months* when the zodiacal light is brightest, and its perfectly formed pyramid is most distinctly traceable in the evening twilight. In no other part of the world have I ever remarked it so well. It is a pyramidal, or rather a lenticular body of light, which appears in the plane of the sun's equator, and is consequently inclined to the horizon after sunset before the vernal, and before sunrise after the autumnal equinox. The light, neither as ruddy as the glow of the sky after sunset, nor as silvery as rays heralding the moon, is usually so faint that few remark it, unless attention be directed to it; then every one wonders why it has so long escaped his attention. It is brightest about the horizon and fades gradually as it recedes; so that it is rarely definable at a greater altitude than 40°. The base of the cone or pyramid was never more than 15°, and generally much less in diameter when its outline became discernible, its apparent breadth depending wholly on the diaphaneity of the atmosphere at the time. It was seen as early as July 6th, and is once noted in our Journal 'very bright' as late as September 6th, its place in the heavens and inclination to the horizon changing as the sun gradually advanced from his northern limit towards us. No variations in the intensity or undulatory motion of the light, such as Humboldt mentions having witnessed in the tropical regions of South America, were ever seen by me in Chili; but only a mild radiance, whose brightness sensibly increased as the twilight faded, and more slowly disappeared an hour later; and by eight o'clock in the early days of September, (corresponding with our March) it was no longer perceptible to eyes that had been so greatly taxed. Whether this beautiful phenomenon consists of a ring of nebulous matter, revolving freely in space between the orbits of *Mars* and *Venus*, or is the outermost stratum of the solar atmosphere, is a question yet to be decided by physicists."

The author makes the following remarks upon the transparency of the atmosphere at Santiago: "Late in the season a sort of dry fog, resembling thin smoke, deprives the atmosphere by day of something of its transparency, though the nights are all that the astronomical observer can desire. Then the Andes, whose crests are not less than eighteen miles distant in an air-line, look almost within stone-throw, and the stars rise over them with a steadiness and brilliancy known in our climate only at mid-heaven. The

* The autumnal months.

observer will appreciate me when he is told that I have made very fair micrometrical measurements of *Venus*, when the planet was not more than 3° above the eastern horizon, and its crescent was more than once seen with the naked eye."

In a separate publication entitled, *An Account of the Origin and Progress of the Expedition*, which is intended to form part of one of the succeeding volumes, we find the following notes on the variations of *η Argus*, extracted from the author's journal :—

" 1850, Feb. 9. A bright, clear night, and steady atmosphere. Comparing the brightest visible stars, they rank— *Sirius*, *Canopus*, *η Argus*, *α Centauri*. The yellowish-red light of *η Argus* is more marked than that of *Mars*.

" Feb. 13. *η Argus* apparently less bright than *α Centauri*.

" March 31. *η Argus* is quite as bright as the two stars of *α Centauri*, and superior to all except *Sirius* and *Canopus*.

" April 15. *η Argus* approaches the brilliancy of *Canopus*.

" April 18. Night cloudless and without haze. After the observations, careful estimation placed *η Argus* quite equal with, if not superior in brightness to *α Centauri*. They were equidistant from the meridian.

" May 14. *η Argus* and *α Centauri* being at the same distance from the meridian, the former is considerably the brighter.

" May 16. *η Argus* more brilliant than the two stars of *α Centauri* combined.

" May 28. *η Argus* goes on increasing steadily. With the ruddiness of *Aldebaran*, its magnitude is only less than *Canopus*. Its change, since the close of October, has been nearly, if not full half a magnitude.

" June 3. To the unassisted eye the atmosphere is remarkably clear, the ' coal-sacks' of the *via lactea* being of startling blackness. *η Argus* and *Arcturus* have approximately the same colour; and although the latter is rather ruddier, the former is considerably the brighter. When compared, they had about the same altitude.

" July 5. *η Argus* is still as bright as the two stars of *α Centauri*.

" July 25. *η Argus* as bright or brighter than the two of *α Centauri*.

" July 28. *η Argus* is on the wane, and is now very little superior to *α Centauri*.

" 1851, May 18. *η Argus* certainly not so bright as *α Centauri*.

" December 28. *η Argus* quite as bright as *α Centauri*.

" 1852, January 22. *η Argus* no brighter than *α Centauri*.

" May 10. *η Argus* continued fully as bright as the double star *α Centauri* as late as the 15th of March last. Some nights I would estimate it a shade brighter; but when the two were at equal distances from the meridian, it was often impossible to detect any difference with the eye. Since then it has sensibly diminished. It comes nearer to my recollection of *Capella*, as seen in the northern hemisphere, than any other star."

It may be remarked, in conclusion, that the two volumes already published contain a large mass of valuable and interesting information on the subjects to which they refer, accompanied with beautiful illustrations, and give promise that the work when completed will redound to the reputation of the author, and to the munificent liberality of the Government of the United States.

Beobachtungen des Bielaschen Cometen im Jahre 1852 *angestellt am grossen Refractor der Pulkowaer, Sternwarte, von O. Struve. Aus den Mémoires de l'Académie Impériale des Sciences de St. Petersbourg. Sixième série, Sciences Mathématiques et Physiques.* Tome vi, St. Petersbourg, 1854.

In this paper, M. Otto Struve gives an account of his observations of Biela's Comet, made with the great refractor of Pulkowa, on the occasion of the last apparition of the Comet in 1852. The first observation of the comet, that of the south following head, was obtained at Rome by Professor Secchi on the 25th of August. The comet was last seen in the Pulkowa refractor on the 28th of September. On this occasion it was the north following head which was visible. The comet was observed only at Rome, Cambridge, Berlin, and Pulkowa. The whole number of distinct observations of one or both of the heads of the comet, obtained during the period of its visibility, amounted to twenty-eight. Only five double observations were obtained, namely, three at Pulkowa and two at Rome. The following are a few extracts from the descriptive notes of M. Otto Struve, accompanying the details of the apparent positions of the comet as determined at the Pulkowa Observatory:—

"Sept. 18. Only one of the heads of the comet was recognised. This was the north preceding head, B. Its apparent diameter amounted to at least 30″. The nebulosity exhibited a considerable increase of brightness towards the centre, but there was no decided indication of a nucleus.

"Sept. 20. Both heads of the comet are distinctly seen. The head B is a little brighter than A, and has also a determinate nucleus. The nucleus of A is not so distinct as that of B. There is seen extending from it an emanation of bright nebulous matter in the direction of B.

"Sept. 23. A is to-night decidedly fainter than B, and exhibits no vestige of a nucleus. The unfavourable state of the atmosphere renders it difficult to perceive the elongated form of A. It is, however, evident that the nebulosity is not uniformly distributed about the point of maximum brightness. The nebulosity of B, on the other hand, is symmetrically situate with respect to the nucleus.

"Sept. 25. A is to-night decidedly fainter than B. A is round, B is somewhat oblong. The brightest part of A is not situate in the centre of the nebulosity, but is turned *away* from B. The nucleus of B, on the other hand, is turned *towards* A.

"Sept. 28. There being bright moonlight and a strong twilight, B was recognisable only with great difficulty."

From the observations of September 20, 23, 25, the author deduces the following results for the apparent distance of the two heads of the comet, corresponding to the mean distance of the sun from the earth:—

Date.	Distance.
	′ ″
Sept. 20	43 2·5
23	42 16·2
25	41 54·2

The emanation of luminous matter from B coincided very nearly in direction with the line joining the two heads. The author is inclined to infer from this fact, that the phenomenon may be regarded as an indication of the effect produced by the action of the two heads upon each other, which was so strikingly illustrated by the interchanges of brightness exhibited by them during the period of their visibility.

Memoir of the celebrated Admiral Adam John De Krusenstern, the first Russian Circumnavigator. Translated from the German by his daughter, Madame Charlotte Bernhardi, and edited by Rear-Admiral Sir John Ross, C.B., &c., with a Portrait and Correspondence. London, 1856.

The subject of this Memoir was a native of Esthonia, one of the Baltic provinces of Russia. He was born in 1770. In early life he served several years in the British Navy. His subsequent career is one of the noblest which are recorded in the annals of any age or country. His labours in hydrography have obtained for him a place among the highest cultivators of nautical science. The editor has given a list of the works published by him at different times during his career. The most important of these is his *Atlas de l'Ocean Pacifique* (1823–6), in two vols. folio. The number of charts is thirty-four. A detailed enumeration of them is given by the editor. Krusenstern was an associate or corresponding member of various scientific societies, including the Royal Society and the Institute of France. He died in 1846, leaving behind him a reputation for exalted moral worth and professional eminence, which will always assure him a high place among the illustrious men of his country.

Professor Colla, Director of the Observatory of Parma, has requested the Astronomer Royal to transmit his thanks to the President and Council of the Society, for the Society's Catalogue of Stars, which was recently presented to him. He has also forwarded an extract from the *Gazette* of Parma, in which he makes known to the Italian public the liberality of several of our institutions to his Observatory. In this publication, he acknowledges the receipt of ten Catalogues of Stars, presented to him by different scientific bodies in this country. One of these, as has been already mentioned, was presented to him by this Society. Five were donations from the Royal Observatory, viz., Airy's Catalogues of 1439, and 2156 stars; Groombridge's Catalogue of Circumpolar Stars; Fallows' Catalogue of Stars; and Maskelyne's Ledgers of Stars. Three Catalogues were presented to him by the British Association, viz., Lalande's Catalogue of Stars, Lacaille's Catalogue of Southern Stars, and the Catalogue of 8377 Stars published by the Association. Finally, one Catalogue was presented by the Royal Society, viz., Cooper's Catalogue of Stars near the Ecliptic. Professor Colla acknowledges his obligation to the Astronomer-Royal for the exertion of his influence in procuring for him these invaluable adjuncts to his Observatory.

M. W. Struve has recently communicated to the Academy of Sciences of St. Petersburg a Memoir on the great Nebula of *Orion*, by M. Liapounov, Director of the Observatory of Kazan. The author's labours extended over a period of four years. His observations were made with an equatorially mounted refractor, equal in optical power to the Dorpat Instrument, and a meridian circle by Repsold. The places of all the stars in the nebula were rigorously determined by a process of triangulation, and its physical features delineated with the most scrupulous care. The author then institutes a comparison between his results and the anterior representations of the nebula by Lamont, Sir John Herschel, and Bond. According to M. Struve the observations of M. Liapounov would seem to indicate that the nebula *is subject to changes of form and relative brightness in its different parts.*

There is at present for disposal a first-class object-glass, by Merz, of Munich, $6\frac{1}{2}$ in. clear aperture, $8\frac{1}{2}$ feet focal length, *with* or *without* tube and powers. Apply at the Apartments of the Society.

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